Special Rations for Long Range Reconnaissance Troops

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INTRODUCTION

In 1987 the Federal Armed Forces decided to develop or search for a light-weight **high calorie** field ration intended for the supply of soldiers on extended special missions outside of the supply area and solely dependent on themselves. Since they have to be provided with all provisions required for the duration of their mission, the field ration is reduced in volume and weight and.comprises various food items of high calorie density specially adapted to the operational conditions of long range reconnaisance troops, frogmen, arnoured reconnaissance units and paratroopers.

The Federal Agency for Defence Technology and Procurement composed two different lightweight rations of high calorie density consisting of ready to eat "energy bars" and **dehydrated** food to which hot water has to be added before consuming, which was specially adapted to the operational conditions of long range reconnaissance troops, armoured reconnaisance troops, and SEALS.

The Division for Exercise Physiology was asked to assist in evaluating possible medical or physiological risks during a planned 20 day field exercise during which only light-weight rations were to be eaten.

INTRODUCTION

The exercise took place from the end of april to the beginning of may at Putlos **shooting range** at the border of the Baltic Sea.

The participants (=subjects(Ss)) of the study were recruited on a semi volunteering basis from three different LRRT companies. The total of 36 men were divided into two groups: 24 test persons (age 22.8 ± 3.6 y and body height 179 ± 6 cm) who consumed the special light-weight ration (SLR) and 12 controls (age 21.8 ± 2. y and body height 180 ± 5 cm) who got the German field rations (GFR). The exercise consisted of typical LRRT-tasks *id est* long distance marching, observing and reporting, shooting and a parachute jump. The observers made sure that no additional food whatsoever was available for either group except tap water ad libitum.

However, they had to protocol the number of water bottles consumed per day. Additionally, the Ss filled in all nutrients not consumed into a nutrition diary so that eating habits and preferences of different parts of the field rations could be deducted together with the whole caloric intake. The medical/physiological tests were obtained on days 1 and 2, 9 and 10, **and 17** and 18 of the field exercise. On the morning of the first laboratory day the Ss **reported fasting** after voiding for measurements of weight (in shorts), body fat according to **Durning and** Womersley and blood withdrawel for the analysis of hemoglobin, hematocrit, glucose, uric acid, triglycerides, total cholesterin, total protein and sodium, potassium and calcium. The second laboratory day was spent in the nearby Institute of Naval Medicine, where cycle ergometry was performed using four ergometers in parallel applying a 2 min 25 Watt step protocol starting at I Watt/kg BW. Ergometry was stopped when HR 170/min was reached or the Ss felt exhausted. The Ss were retested on the same cycle ergometer at the same **time of** the day to reduce intraindividual circadian influences. From the HR response to

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the cycle ergometry the Watt load was calculated for which the S needed a HR of 170 min '; this is called Physical Working Capacity at heart rate 170 min^{-1} (PWC_{170}). Division by body weight results inthe relative PWC_{170} [Watt/kg].

RESULTS

By introducing the new special light-weight rations the total weight to be carried by the LRRT for a 20 day patrol was reduced by 30 % or 22 kg. Thus the first aim was reached. The psychological effects of the food were interesting. Prior to the experiment, the SLR was looked upon as "space food" or something very special and the control group was pittied to have to eat the unloved SFR. After seven days the opinion had changed completely: the test group envied the control group for their food and the control group teased the test group for getting "soups only".

The physiological results were as follows: (Table I).

Table I. Anthropometry

Measure	Group	Date		
		18 April	26 April	4 May
Body Weight (kg)	Army Test Group Army Control Group	75,5 78,2	72,7 76,7	71,6 75,9
Rel Fat Content (%)	Army Test Group Army Control Group	16,2 15,7	14,6 15,2	13,7 13,9
Fat Free Mass (kg)	Army Test Group Army Control Group	63,1 65,9	62 65,1	61,7 65,4

Both groups were identical with respect to age, body weight, body height and body mass **index** (BMI), although the control group consisted of only 12 Ss while the test group comprised 24 Ss.

Body weight in both groups decreased during either week, the drop during the first week, however, was more pronounced. In total the test group lost 3.9 kg while the control group lost 2.3 kg which is 5.2 and 2.9%, respectively, of the initial body weight. In the control group this weight loss was not caused by a hypocaloric supply but by a combination of boredom by the repetitions of GFR and an intended weight reduction during a period of high energy **output.** The latter effect has been observed with US military as well.

Relative body fat was also reduced in both groups in either week. The test group lost 2.6% points while the control group lost 1.8% points. This is 16% and 11.5%, respectively, of the initial value.

Fat free body mass decreased -surprisingly enough- too. The amounts, however were **small** although in the test group statistically significant: the test group lost 2.2% FFM and the control group gave up 0.8% of their FFM.

From the weight losses and from the food consumed we calculated an average daily energy turnover of 3700 kcal which, according to German definition of work physiology, is strenuous work.

The data of the blood analyses are summaried in table II. The blood analysis showed a paralled drop in hemoglobin and hematocrit of approximately 6% in both groups. All values, however, remained well with in normal physiological limits. The cause for this finding is **uncertain and** may be explained by the experts present at this meeting.

Table II. Data of blood analyses

Measure	Group	Date		
		18 April	26 April	4 May
Serum Sodium (mmol/l)	Army Test Group Army Control Group	140,7 142	140,3 140,9	140,6 140,4
Serum Potassium (mmol/l)	Army Test Group Army Control Group	4,2 4,2	4,4 4,2	4,3 4,2
Serum Calcium (mmol/l)	Army Test Group Army Control Group	2,4 2,4	2,4 2,4	2,4 2,3
Total Serium Protein (g/l)	Army Test Group Army Control Group	68,7 68,4	71,5 67,5	73,5 71,5
Serum Clucose (mg/dl)	Army Test Group Army Control Group	77,1 80	78,5 78,7	70,9 73,9
Serum Triglycerides (mg/dl)	Army Test Group Army Control Group	113,4 167,5	49,1 61,1	66 88,1
Total Serum Cholesterin (mg/dl)	Army Test Group Army Control Group	200,5 207,5	162,7 175,7	152,9 163,9

The changes in serum electrolytes were minute and in either direction. From this we state that neither food preparation would cause an electrolyte deficit.

Total serum protein increased during either week in the test group while in the control group it rose quite pronouncedly during the second period after an initial drop during the first period. All increases are statistically highly significant and totalled in +7.1 and +4.5%, respectively. This finding was surprising as the drop in hematocrit could have been interpreted as **hinting to** a hemodilution while the increased total serum protein would point towards a hypohydration due to the strenuous exercises and the hypocaloric diet. This idea is supported by the finding that the control group showed only an insignificant drop in total serum protein in the first period, when they consumed almost all of the GFR, while during the second week, **during which the** consumed less (because they were fed up), the incresase was almost as **great as the** total augmentation over the whole period in the test group.

Serum glucose concentrations showed an overall drop of roughly 8%, which is statistically significant. As the changes observed in the first week were bidirectional and not statistically significant and as the decreases measured in the second period were statistically significant this may be explained as an effect of the hypocaloric nutrition which, in the second period, was pronounced in both groups.

This is supported by the changes observed in serum triglycerides: They dropped by **more than** 40% in either group over the whole period. During the first part of the exercise this drop was even more pronounced amounting to more than 50%. This is a well-known effect of periods of high-energy turnover and intended by those soldiers who know about it. Total serum cholesterol depicted si mi l ar behavi our : the total d rop was about 2 5% with a greater reduction in the first week as compared to the second week. All changes except the drop in the second period in the control group were highly significant. This is to a certain extent surprising as the initial values of 200+35 mg/dl were indeed not very high. Unfortunately the laboratory was not able to differentiate into HDL and LDL sub groups. However, changes in these subpopulations have already been documented by others.

After the biochemistery of blood showed no alterations that could not be tolerated from a standpoint of nutrition physiology it seems interesting to look into the data **of cycle ergometry,** the data of wich are summarized in table III.

Table III. Results of the cycle ergometry

Measure	Group	Date		
		18 April	26 April	4 May
PWC_{170} per kg actual BW	Army Test Group Army Control Group	3,5 3,2	3,7 3,5	3,9 3,8
PWC_{170} per kg actual FFM	Army Test Group Army Control Group	4,2 3,9	4,3 4,1	4,6 4,4

Both groups showed a rather high value of the relative PWCl70 i.e. 3.57 and 3.29 Watt/kg. These data, related to fat-free body mass, will amount to 4.27 and 3.90 Watt/kg FFM. **During** the observation period, this measure of physical fitness increased to 3.95 Watt/kg BW and 4.65 Watt/kg FFM in the test group and to 3.83 Watt/kg BW and 4.49 Watt/kg FFM in the control group. The latter increase was more pronounced. However, the control group having a lower value to start with, it could be argued that the identical training stimmulus led to a higher training effect in the (slightly) less trained group.

One of the problems with dry food is the water supply. The control group consumed almost 2 I/day while the test group used 0.5 I/day more. This is on one hand surprising as **the water** deficit of the LSR is more than 500 ml, on the other hand one could assume that the control group had a higher water output, which we were not able to control. Anyhow, a water turnover of 2 or 2.5 l/day is adequate for strenuous exercise conditions during spring time on the borders of the Baltic Sea. The control of early morning urine for ketone bodies, which was done by the Ss using test-sticks gave no hints for keton uresis.

The results show that dehydrated food with a caloric content of 2100 koal/day is well tolerated by LRRT in spite of the fact that a decrease in body fat content was observed.

Ergonomic improvements resulted in food containers into which the hot water could be poured without the need to use the mess-tins and additional water for "dish washing".

In the meantime the variety of dishes has been augmented. It comprises 27 different food items as well as multipurpose paper, matches, plastics bags, and water purification tablets wich are combined to 5 types of ration sets (type I through V).